DISCUSSION OF THE AMENDMENT

Claims 1, 16 and 23 have been amended by incorporating the subject matter of Claims 57 and 59 therein; Claims 57 and 59 have been canceled. Claims 58 and 60 have been amended to depend on Claim 1.

No new matter is believed to have been added by the above amendment. Claims 1-55, 58, 60, 61 and 75-77 are now active; Claims 56 and 62-74 stand withdrawn from consideration.

REMARKS

The rejections of:

Claims 1-55, 57-61 and 75-77 under 35 U.S.C. § 102(e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over, US 6,582,513 (Linares et al),

Claims 1-55, 57-61 and 75-77 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over, US 5,443,032 (Vichr et al),

Claims 1-51, 53-55, 57-61 and 75-77 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over, JP 7-277890 (JP '890), and

Claims 1-51, 53-55, 57-61 and 75-77 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over, Michler et al, *Complementary application of electron microscopy and micro-Raman spectroscopy for microstructure, stress, and bonding defect investigation of heteroepitaxial chemical vapor deposited diamond films*, J. Appl. Phys., Vol. 83, No. 1, 187-197 (1998) (Michler et al),

are respectfully traversed.

Applicants continue to rely on the arguments made in the previous response, as supported by the Declaration under 37 CFR 1.132 of named coinventor Dr. Geoffrey Alan Scarsbrook (Scarsbrook Declaration) submitted therewith.

The Examiner, in response to these arguments, refuses to accept the statements declared by Dr. Scarsbrook, at least to the extent they go to showing error in the above-listed rejections, for reasons stated at page 3 of the Office Action.

To reiterate, the present invention relates to the provision of diamond material with improved optical characteristics, for example reduced birefringence, not previously obtained in synthetic diamond.

In order to achieve these optical characteristics, the inventors have found that it is necessary to control the level of nitrogen contained in the diamond material. In particular

they have found that these levels must be significantly below that of "ordinary" nitrogen contamination levels that result from using conventional CVD diamond processes, for example where the nitrogen is inherently introduced as an impurity in the hydrogen and methane source gases, but also that the nitrogen concentration must not be zero. The independent claims now recite a nitrogen concentration range in order to achieve the above optical characteristics, i.e., more than 3×10^{15} atoms/cm^3 and less than 5×10^{17} atoms/cm^3 as measured by electron paramagnetic resonance (EPR). For ease of comparison, 3×10^{15} atoms/cm^3 equates to a parts per million concentration of 0.017 ppm (or 17 parts per billion (ppb)) given that diamond has an atom density of 1.762×10^{23} carbon atoms/cm^3. Likewise, 5×10^{17} atoms/cm^3 equates to 2.84 ppm, i.e., approximately 3 ppm.

Thus, the insertion of such a range in the independent claims answers the Examiner's point that the previous argument regarding the significance of the nitrogen content was not persuasive because no claims recited such a range -- the claims were either silent, or recited only an upper limit, or recited only a lower limit.

While not being limited to any particular theory, as explained in the Scarsbrook Declaration, it is believed that the presence of a very small amount of nitrogen reduces the rigidity of the diamond structure and thus reduces the stress associated with any strain surrounding any existing dislocations within the diamond structure. If this strain is not reduced there is the risk that it would lead to propagation of additional dislocations throughout the remaining diamond growth, which in turn would have an adverse affect on the material's optical properties. On the other hand, too much nitrogen results in the formation of more complex nitrogen-containing defects and in the incorporation of non-diamond carbon species that result in broad, ill-defined optical absorption bands, and thus in material with poorer optical characteristics.

Linares et al is primarily concerned with producing CVD diamond with good thermal properties using a method that controls a combination of carbon isotope and nitrogen concentrations. However, the nitrogen levels in the solid diamond material are significantly higher than the maximum permitted in the present invention. It is acceptable in Linares et al for the resulting diamond material to contain 50 ppm N, with preferred amounts down to less than 5 ppm. A ceiling of 3 ppm is not contemplated. Also, there is neither disclosure nor suggestion whatsoever in Linares et al of the benefits of having a minimum amount of N present. This is not surprising given that Linares et al is concerned with achieving good thermal properties, where the N level is not as critical as it is for optical properties.

Vichr et al describes a method for making large single crystal CVD diamond material by growing the material on an array of small diamond seeds. Vichr et al seeks to obtain electronic quality diamond. Other than mentioning the need to reduce impurities, Vichr et al does not address reducing the N content to a very low level, and furthermore, nowhere discloses or suggests the need to maintain the N level above a certain minimal concentration. Vichr et al neither discloses nor suggests the present invention, i.e., that high optical quality diamond material with newly-obtained optical characteristics can be obtained by careful control of N concentration within a given concentration range.

JP '890 relates to a CVD process wherein nitrogen is deliberately added to the source gases during synthesis to increase the diamond growth rate. JP '890 does not address the addition of a low concentration of nitrogen into the diamond material, within defined minimum and maximum amounts, in order to produce certain optical characteristics. It is noted that paragraph 39 of the Scarsbrook Declaration addresses JP '890, which paragraph presumably has been accepted by the Examiner because it is not rebutted in the Office Action.

Michler et al, as acknowledged by the Examiner, is similarly silent on nitrogen concentration.

For all the above reasons, it is respectfully requested that the rejections be withdrawn.

All of the presently-active claims in this application are now believed to be in immediate condition for allowance. Non-elected Claim 56 contains all the limitations of the active claims and thus should also be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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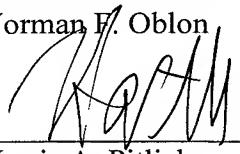

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